# 9 Editing Procedures

*Editing procedures should be an integral part of the QNA. The objective of editing is to validate the consistency of the quarterly results within the national accounts and with other related economic information. A number of logical and plausibility checks are suggested for identifying common problems in the various stages of the quarterly GDP compilation process. This chapter also proposes the use of available annual supply and use tables as an editing tool to address and resolve the quarterly GDP discrepancies at a detailed level.*

## Introduction

**1** Editing procedures are essential steps of statistical production and are among the tasks in national accounts compilation that require the greatest skill. While other chapters deal with the sources of data and techniques, this chapter emphasizes reviewing and understanding the data. The process of reviewing and understanding data can be called "editing," "checking," or "data validation." It should occur at all stages—before, during, and after—of the calculation of the estimates. "Reconciliation" or "confrontation" is a special kind of editing done after initial compilation, in which alternative data are checked in the context of national accounting relationships. Editing may involve fixing errors or adopting alternative sources and methods.

**2** Quarterly national accounts (QNA) results should be evaluated and understood before their publication. National accounts compilation is a complicated process, bringing together a wide range and large volume of data. The data come from varying sources, are of varying quality, cover different periods, and may have different units, concepts, and timing. Large volumes of data and tight deadlines mean that mistakes are easy to make and hard to find. In addition, when a method or program has worked well in the past, the production process has gone smoothly, or the calculations are complicated, there is a natural tendency for busy compilers to accept the data without close scrutiny, resulting in a risk of errors. Editing (or checking) procedures should be put in place to review all the different stages of the QNA calculation process and make sure that the final results satisfy all the national accounts relationships and provide a credible measurement of the economy.

**3** Many of the editing and reconciliation issues in QNA are the same as in annual national accounts (ANA). However, these issues are particularly important in the compilation of QNA. Deadlines for QNA are usually much tighter than for ANA, work is more rushed, and a higher proportion of source data may be preliminary or unpublished. As a result, errors are more likely to occur. There is typically less detailed information in QNA. The tight deadlines applying to quarterly compilation impose a severe limit on the amount of investigation done for the latest quarter. In the time available, it may be necessary to limit checks to known problem areas, the most recent periods, and some major ratios. In the time between the end of one quarterly compilation cycle and the beginning of the next, however, there may be opportunities to undertake further investigation.

**4** Editing procedures should aim at monitoring and reviewing the quality of the data and methods used, and also interpreting the key messages from the QNA results. A number of methods should be put in place to control and validate input data, intermediate steps, and final results. A basic principle in this validation process is that the QNA results should reflect the data sources. Any deviation from sources should clearly be investigated and explained. Second, QNA should be internally consistent and satisfy all the national accounts relationships at both the aggregate level and the detailed level. This includes consistency with published ANA. QNA series should also be comparable over time and show no artificial breaks between one quarter and the next. Finally, QNA data should be consistent with other qualitative and quantitative information measuring the current state of the economy.

**5** Balancing alternative measures of gross domestic product (GDP) is a particular kind of editing designed to reduce or eliminate inconsistencies between measures derived from the production, expenditure, and income approaches. These inconsistencies arise from the use of numerous and varied source data when developing the measures. In theory, GDP calculated by the production approach is equal to the value of GDP calculated by the expenditure and income approaches. At a detailed level, the GDP equivalence transforms into the fundamental economic identity that the supply of products must equal their use. In practice, however, discrepancies generally occur because the supply and use of products are estimated using different data sources.

**6** Editing procedures may result in changes to the estimates. They may involve fixing errors or adopting alternative sources and methods. It is important that such changes are justified and documented. For example, sometimes mistakes are identified and the correct figure can be used instead. In other instances, a method may have become unsuitable because the assumptions behind it have become obsolete, or the source data may have problems in reporting or coverage.

**7** The editing work should never be an excuse for manipulating data without evidence, adjusting data to fit forecasts, or for political reasons. A distinction needs to be made between editing and unacceptable manipulation of data. An unexpected change in a series should lead to checking that there is no error or problem with the data source. Editing may suggest that an alternative source or method is justified; however, data should not be changed just because they are unexpected, as this may lead to charges of manipulation and may undermine the reputation of compilers if it becomes known. Further, in reality, many unexpected developments occur, and the purpose of QNA is to show actual developments in the economy, particularly when they are unexpected. In line with principles of integrity and transparency, QNA estimates should be explained by reference to source data, publicly available compilation methods, and adjustments documented with the supporting evidence.

## Editing as Part of the Compilation Process

**8** Editing is an iterative process for validating the quality of QNA data. Editing should involve all stages of the QNA compilation process. Editing procedures should be organized into a systematic framework that allows compilers to identify and address promptly any shortcomings in the input data, intermediate or final QNA results.

**9** Editing can occur at all stages of data processing:

a. before receipt by the national accounts compilers,
b. during data input (i.e., the data as supplied to the national accounts compilers),
c. during data output (i.e., the data as planned to be published), and
d. during intermediate stages:
   i. before and after benchmarking,
   ii. before and after deflation,
   iii. before and after balancing,
   iv. before and after seasonal adjustment, and
   v. before and after other major adjustments (for timing, coverage, etc.).

**10** Editing at each stage is desirable. Each stage of processing and adjustment can introduce new errors or hide earlier ones. Earlier identification of problems and errors is generally preferable.

**11** Good editing practices should be applied by all compilers of statistical data. Data suppliers are an integral part of national accounts compilation, so editing should be supplemented by continuing contact with suppliers to gain knowledge from them about problems they have identified or suspect. Those who collect the data need to monitor the results and anticipate queries for their own purposes. In some countries, the national accounts compilers have contributed toward educating the data collection staff through the perspective that comes from seeing macroeconomic links, from undertaking deflation and seasonal adjustment, and from maintaining consistent time series. The national accounts compilation process itself may shed new light through volume measures, seasonally adjusted and trend-cycle data, analysis of revision patterns, and reconciliation with related data sources.

**12** In addition, national accounts compilers may have meetings or standardized data supply forms to allow the data collectors to notify them of major movements in the data, known economic developments, response rates, standard errors, changes to questionnaires, and other changes in methods. Good procedures or structures for interaction between data collection staff and national accounts compilers are essential for data validation as well as for helping maintain effective cooperation and avoid conflicts. Thus, communication needs to be in both directions.

**13** Original estimates, adjustments, and reasons should be documented along with supporting evidence. As a good practice, when national accounts data are changed during the editing process, the source data, original estimates, and adjusted estimates should be stored. Although only the adjusted data will be published, it is important to be able to document how the source data were amended and the cause of the problem. Documentation is necessary so that the reasons may be understood and verified later. While it is tempting to put off documentation work, memories are not a good substitute, because people move on to other jobs, forget, are on leave at a crucial time, or have conflicting recollections. Documentation is a defense against accusations of manipulation. As later data become available, patterns may be more apparent from a consistent series of original data, or alternative adjustments may be developed. Later information may lead to the conclusion that some adjustments were ill-advised and should be revised. Documentation could be on paper files or, better still, on the computer system if it allows different versions of a series to be saved and associated metadata to be linked to a series.

**14** The ability of the national accounts compiler to make adjustments is limited if consistency with some or all published source data is a constraint. In some countries, particular data are regarded as binding for QNA compilation because of their relatively high quality or need for consistency (e.g., exports and imports of goods and services). On the other hand, data that are known to be particularly poor are identified as being subject to adjustments (e.g., consistency between the production and expenditure estimates being achieved by adjustments to changes in inventories because the source data used to compile that component are known to be of poor quality).

**15** The highest priority in editing is usually to identify and remove errors before publication; however, there are other benefits. Editing helps national accountants understand the data and the economy better. It also helps national accountants anticipate queries from users, because unusual movements will already have been identified; explanations for the expected queries can thus be given immediately. Successful editing enhances both the quality of the data and the confidence of users in the compilation procedures.

**16** Editing procedures usually rely on relationships within data to identify problems and questions. Only rarely will looking at a single number help point to anomalies. The foundation of editing is to compare observations of the same variable in different periods or to compare one variable with other variables that are expected to have some linkage.

**17** The analysis of revisions is another important tool of the editing framework. Substantial differences with previous estimates of the same quarter should be understood and validated. Revisions that are caused by new or updated source data are generally justified, provided that they are plausible in economic terms and consistent through the accounts. When large revisions are generated by statistical procedures (such as seasonal adjustment), a thorough investigation must be conducted to verify that there are no glitches in the methodology and that these revisions measure in the most accurate way what is happening in the economy.[1]

**18** Deciding how much editing work to do depends on staffing, deadlines, and knowledge of the kinds of problems that typically arise. In theory, more editing is always better. In practice, the extra work and time required to establish editing systems and then check the data mean that edits must be limited to the types that are most likely to be useful.

**19** Computers have greatly increased the capacity for editing. Automated routines should be developed

[1] For more details on revisions of QNA data, see Chapter 12.

to monitor the QNA results quickly and continuously during the compilation process. Compilers should be able to evaluate the impact of any change in the data, both for the variables directly involved and for the system as a whole. At the same time, computerized systems may need more checking because the data processing itself involves less human observation. Computerized tools require maintenance from time to time, for example with the beginning of a new year or when a new classification is adopted.

**20** The compilation schedule needs to allow time for editing and subsequent investigation and revision of data. If time is only allocated to carry out basic data entry and calculation tasks, it will not be possible to make any changes before the publication deadline.

**21** More complicated estimation methods for particular components are at more risk of mistakes. Similarly, the need for editing is stronger when data or methods are weak because the risk of inappropriate results is greater. Because numbers in a computer are all treated as numbers regardless of their origin, it is important for the compiler to bear in mind the link between the quality of data input and the quality of data output: "garbage in, garbage out."

## Causes of Data Problems

**22** There is a range of causes for failure of data to fit expected relationships. When there is a data problem, it is first necessary to confirm that the input data are consistent with those supplied by the data collectors. Next, it is important to confirm that the computer program is doing what was intended. This check will show whether any anomalies were due to mistakes made in the national accounts compilation system itself. In the interest of good relationships with data suppliers, the possibility of an error in the compilation system should be excluded before pursuing other avenues of inquiry.

**23** Typical errors leading to data failing to fit expected relationships include the following:

a. *Errors in data entry by national accounts compilers.* These include mistyping of numbers, putting numbers in the wrong place, and using old data that should have been updated.

b. *Errors in national accounts compilation systems.* At a basic level, these include wrong formulas, which are particularly likely when changes are made to programs, especially in spreadsheets. In addition, the assumptions and indicators may become inappropriate as conditions change; for example, use of a generalized deflator or direct deflation of value added may give acceptable results when there is little relative price change, but may become quite misleading under different economic circumstances. Adjustments are required when data sources do not fully meet national accounts requirements and are particularly prone to becoming outdated by economic changes. Examples are adjustments for timing, valuation, and geographic/size/product coverage.

c. *Errors in data recording by respondents.* Reporting quality is often a problem, but it can be improved by good questionnaire design, helpful completion instructions, and availability of assistance in completing forms. Timing problems can be particularly important in QNA. Timing problems occur when transactions are not recorded at the time required by the *2008 SNA*. The *2008 SNA* standard is based on accrual principles and change of economic ownership; however, many data sources do not meet these requirements. Government data are often recorded on a cash basis. International trade data are typically recorded at the time the goods cross the customs frontier or when the customs authorities process the form. Administrative by-product data (e.g., value added or payroll tax data) may cover periods that do not coincide with a quarter because the agency is more interested in tax collection than statistical objectives. Businesses may also use different accounting periods that do not exactly match the three-month period used in the QNA, such as weeks, four-week periods, or nonstandard quarters. These problems are also found in annual data but are more significant in QNA, because a timing error of the same size is relatively larger in quarterly data.

d. *Errors and problems in source collection systems.* Problems can occur in classification, data entry, estimation of missing items or returns, sample design, tabulation, treatment of late response, incomplete business registers, and omitted components. Estimation of non-reporting units is a particularly important issue for QNA because of the higher proportion of missing data owing to earlier deadlines. Early estimates are often based on incomplete response, complemented by estimation processes for the missing respondents. Treatments of outliers may also differ. A systematic difference between early and late estimates suggests that the estimation for the missing components is biased. Large but nonsystematic errors suggest that it would be desirable to put more effort into early follow-up. National accounts compilers need to be sympathetic to the constraints of resources and respondent cooperation faced by their data collection colleagues.

**24** Errors should clearly be distinguished from real changes in the economy. Changes in the structure of the economy, for example, may also fail to fit expected relationships; nevertheless, they should never be considered errors. For instance, it is possible to confirm that there has been a surprising but valid change in the series owing to a known cause, such as a large individual transaction or a business closure. This information helps the national accountant understand the data and deal with queries from users. Some changes in the structure of the economy have the effect of making assumptions used in the national accounts compilation obsolete and so may require changes in methods. For example, the representativeness of an indicator that does not fully match the required coverage may deteriorate.

**25** Atypical changes may cause concerns from users. Movements outside the normal historical range should always be identified and understood. When changes are relevant for the economy as a whole, they should be accompanied by clear explanatory notes in the press release. In all other cases, it is always better to know how to explain such cases so that a query from a user is not a surprise and an explanation can immediately be provided.

**26** The causes of some data problems are obvious, while in other cases investigation is needed to identify the cause. Some can be resolved easily, while others involving data collection will take longer to implement; examples of the latter may include problems that require changes in survey coverage or questionnaire design, design of new imputation methods for nonresponse, or revised procedures for incorporation of new businesses in surveys. Even where it is not possible to fix or explain data immediately, it is important that the issues be identified for later investigation and resolution.

## Methods for Identifying Data Problems

**27** The most basic form of editing is done by just looking at the numbers as they will be published, without any additional calculations, tabulations, or charts—a practice referred to as "eyeball testing." Even with a limited presentation of data, a number of potential problems will be apparent to the careful eye:

a. different orders of magnitude and different numbers of digits,

b. numbers that change too much—excessive growth or decline,

c. numbers that do not change at all—no change at all may suggest that numbers have been copied into the wrong period,

d. numbers that are inconsistent with other economic data, and

e. numbers that change too little—a much slower growth than other items may point to a problem.

**28** Eyeball testing does not use a computer or other tools to pinpoint problems, so it depends solely on the editor's ability to detect possible inconsistencies. As a result, many data problems will not be apparent and may be missed. Despite these limitations, such a basic examination can be implemented quickly and is much better than no editing at all. Someone who was not involved in the original calculations is more likely to notice potential problems. For example, the entire QNA team should have access to the final publication prior to release to spot possible inconsistencies or mistakes.

**29** The final QNA results should always go through a rigorous system of logical and plausibility checks before publication. Many problems in the estimates are only revealed by comparing different variables of the accounts or by making additional calculations. This entails a more sophisticated and time-consuming form of editing. However, modern computer systems allow the implementation of complex editing tools in a very efficient and systematic way.

**30** More advanced forms of analytical editing can be done with charts or tables. Usually, the interest in this case is in big changes rather than precise relationships. Charts are particularly suitable in this task because they can be read by glancing, especially to identify outliers. Line charts and bar charts are alternative presentations that give different emphases. Charts may sometimes take more time to set up than tables, but are worthwhile because of their usefulness. Tables allow errors to be traced more easily because an exact number is known, so they might be used to investigate a problem detected by a chart. Both charts and tables can easily be standardized and updated continuously during the editing process. Different formats each have their own uses, so it is desirable to have a range of presentations.

**31** In general, editing procedures are best applied at both detailed and aggregate levels. In aggregate form, problems can be hidden by large values of data or by errors in offsetting directions canceling each other out. With more specific identification of the affected components, it is possible to focus on the cause of the problem. Some problems are only apparent at a detailed level, because they get swamped at a higher level of aggregation. In other cases, the level of "noise" or irregular movements in the series is high at a micro level, so problems may become more obvious at a higher level, as the noise in the series becomes relatively smaller. Later in this chapter, a simplified supply and use model is described to transform aggregate GDP discrepancies into detailed imbalances at the product level.

**32** Problems are sometimes more apparent in volume and seasonally adjusted data. These presentations remove some sources of volatility and hence isolate remaining fluctuations. For example, an unadjusted series may have a strong seasonal pattern, with quarter-to-quarter changes so large that trends and irregularities are hidden.

**33** Some logical and plausibility checks are presented in this section, which can be taken as a reference and adapted to the particular QNA compilation system implemented by each country.

### *Logical*

**34** Logical edits are those in which exact relationships must hold, based on mathematical identities or definitions, such as in the following examples:

a. Total is equal to the sum of components (e.g., GDP = Household final consumption + Nonprofit institutions serving households consumption + Government final consumption + Gross fixed capital formation + Changes in inventories + Acquisitions less disposal of valuables + Exports of goods and services – Imports of goods and services and Manufacturing = Food + Textiles + Clothing).
b. Commodity balances, which are checks of the relationship between supply and use when they have been derived independently. They can best be done as a part of a comprehensive supply and use framework in which balancing and interrelationships between components are dealt with simultaneously. Even without a comprehensive supply and use framework, however, balancing supply and uses of particular products is a useful way to find errors or inconsistencies between data from different data sources.
c. Definitions of specific terms (e.g., Implicit price deflator = Current price value/Constant price (or chained) value and Value added = Output – Intermediate consumption).
d. Year is equal to the sum of the quarters for original data. For seasonally adjusted, working-day adjusted, or trend-cycle data, this edit applies when the quarterly transformed data are benchmarked to the annual unadjusted data. Otherwise, the discrepancy between the sum of seasonally adjusted data and the annual unadjusted data should be monitored (see Chapter 7 for further details on how to assess the consistency between annual data and seasonally adjusted data).

**35** Rounding errors may sometimes disturb these relationships slightly, but they should be relatively minor and not used as an all-purpose excuse for acceptance of inconsistency.

### *Plausibility*

**36** Edits of plausibility rely on expectations of how series should move in relation to past values of the same series and to other series. In contrast to logical edits, there is not an exact requirement that the data must satisfy; rather, data can be seen as being in a spectrum that goes from expected values to less expected but still believable values, to unusual values, and on to unbelievable values. This assessment requires an understanding of what is a realistic change: that is, the national accountant must have a good grasp of economic developments as well as an understanding of the statistical processes.

**37** It is important to assess QNA indicators for their ability to track movements in the corresponding annual series. As explained in Chapter 6, the annual benchmark-to-indicator (BI) ratio shows the relationship between the two series. A stable annual BI ratio shows that the indicator is representative. Alternatively, a trend increase or decrease in the BI ratio points to bias in the movements of the indicator series. Volatile changes in the annual BI ratio point to problems that are less easily diagnosed and solved.

**38** The following are some other editing calculations that can be made to assess the plausibility of data:

a. Percentage changes (e.g., for quarterly estimates, compared with one quarter or four quarters earlier) can be calculated. These can help identify cases where rates of growth or decline are excessive, or where one component is moving in a different way from a related series. It may be feasible to develop thresholds to identify unusual changes on the basis of past behavior. As well as being useful in editing, percentage change tables are a useful supplementary way of presenting data.
b. Changes in level (in addition to percentage changes) can also be used to check the magnitude of increase or decrease for variables expressed in value terms or for constant price data with the same base year.
c. Contributions to change, which show the factors behind growth in aggregates (rather than just growth of series in their own right), can reveal excessive positive or negative contributions from one specific industry, or one specific expenditure component.[2]
d. Commodity balances can be made.[3] If one item is derived as a residual, this item should present regularity over time and can easily be interpreted from an economic point of view.
e. Ratios of various kinds can be calculated (particularly where series have independent sources):
   i. Implicit price deflators—that is, the ratio of current price values to constant price values—are a kind of price index.
   ii. At a detailed level, if the value and volume measures have been obtained independently, a peculiar implicit price deflator movement could indicate incompatible trends between the current price and chain-linked (or constant price) source data.
   iii. At an aggregated level, it is useful to calculate the corresponding Laspeyres price indices. Comparison between the Laspeyres price indices and implicit price deflators points to the effect of compositional changes on the implicit price deflators. No extra data are required to calculate the Laspeyres price indices, and they are of analytical interest in their own right.
   iv. Productivity measures show the relationship between inputs and output/value added, and hence may point to problems in input or output data. The most common and simple measure is labor productivity: that is, output or value added in chain-linked form (or at constant prices) per employee or hour worked. For example, the output, value added, and employment series may look reasonable individually, but they could be moving in incompatible ways. In this case, the productivity measure will highlight the inconsistency in the trends by the implausible movement. Some countries publish labor or total factor productivity estimates; again, these are of analytical interest.
   v. Ratios between other closely related series (e.g., construction in gross fixed capital formation and construction output in production estimates; value added and output for the same industry; components to total ratios, such as manufacturing/total; and inventories/sales).
   vi. Other ratios between series. Less stable ratios will occur for series that are linked by

[2] Calculated as $(x_t - x_{t-1}) / A_{t-1}$, where $x$ is the component series and $A$ is an aggregate. For example, if household consumption has increased by 5 since the previous period and gross domestic product (GDP) was 1,000 in the previous period, the change in household consumption makes a contribution to GDP growth of 0.5 percentage point. For further details on the calculation of contributions to change, see Chapter 8.

[3] These are already discussed under logical edits. If the supply and use data are complete, this is a logical edit. If the supply and use data are incomplete, this is more a test of plausibility.

behavioral relationships: for example, consumption and saving to income, and current account deficit to saving. However, changes in these ratios can point to data problems and also help national accounts compilers advise data users.

f. Implicitly derived series should be examined closely, as they may highlight data problems: for example, intermediate consumption when value added has been derived with an output indicator.

g. Revisions (since the previous publication or several publications earlier) should be examined.[4] Newly introduced mistakes will show up as revisions. Consistent patterns of revisions (i.e., upward or downward) suggest a biased indicator. Large, erratic revisions may indicate a problem with early data that can be investigated. The incorporation of annual benchmarks into quarterly estimates will cause revisions and could reflect problems in the sources or methods for either annual or quarterly data. To calculate and track down the causes of revisions, it is necessary to archive data from previous releases, by keeping printouts and copies of computer files or by saving earlier data in the computing system under separate identifiers.

**39** It is not a coincidence that many of these tools for plausibility editing are also of interest to users of the statistics. Both editors and analysts are performing similar tasks of looking at how the data are moving and why. Performing these tests during the compilation work facilitates the task of addressing possible requests for clarification from users.

**40** Discrepancies and residual items should receive particular attention because they are not derived directly, and problems in certain components are often highlighted by the balancing item. The next sections deal with the problem of addressing and balancing discrepancies between different measures of quarterly GDP.

## Balancing Quarterly GDP Discrepancies

**41** When there are two or more independent measures of an item, inconsistencies inevitably will arise. The inconsistencies could be between two measures of GDP estimated by different approaches or, in a detailed system, between the supply and use of a particular product. Balancing[5] is the process of dealing with these inconsistencies. This section discusses different options for reconciliation and the considerations that need to be taken into account in choosing among them. Balancing issues arise all the time in both annual and quarterly estimates. The approach to ANA reconciliation will typically be the starting point for QNA, although some different approaches may emerge because of the quarterly emphasis on speed and time-series maintenance. In addition, the QNA data will be strongly influenced by the balancing carried out in the annual data, because the annual balances (or imbalances) will be passed to QNA through the benchmarking process. The options available are balancing by detailed investigation, balancing by mathematical methods, or publication of discrepancies in varying ways.

**42** One important type of balancing is the process of adjusting data at a detailed level within a full supply and use (or input–output [IO]) table framework or through commodity balances for key products. Supply and use tables (SUT) provide a coherent framework to identify inconsistencies at the detailed product level. Supply and use balancing is at its most useful when investigations are used to identify the cause of discrepancies. Even if supply and use data are not available in a comprehensive framework, a partial version in the form of commodity balances for particular products can provide some of the benefits of SUT for balancing. A few countries use a supply and use framework on a quarterly basis, typically at a less detailed level than annually and as a compilation tool that is not intended for publication. SUT can also be used as an editing tool for the quarterly GDP, as discussed in the next section.

**43** Another type of balancing occurs when there are independent estimates of GDP by two or more approaches but without the details of a supply and use framework. In such cases, discrepancies become

[4] Chapter 12 presents an analytical framework to conduct a quantitative revisions analysis.

[5] In the previous version of this manual, the term "reconciliation" was used in place of "balancing." To avoid any confusion with the reconciliation techniques discussed in Chapter 6, the term "balancing" is preferred in this new edition. However, balancing and reconciliation can be given the same meaning in the context discussed.

apparent only when the data are aggregated, making well-based balancing difficult or impossible because the aggregate discrepancies provide no indications of which components are causing the discrepancies. Investigations may still prove useful, however, as patterns in the discrepancies may point to specific problems (e.g., reversed fluctuations point to timing problems, persistent differences of a similar size point to a bias in a major source, and procyclical differences may point to problems in measuring new businesses).

**44** Some countries have a mix of methods in which supply and use balancing occurs on an annual or less frequent basis, while independent estimates are made quarterly. In these cases, the quarterly discrepancies will cancel out within the quarters of balanced years and generally tend to be smaller because of the benchmarking process.

**45** A number of countries do not have an apparent problem of balancing, because they do not have SUT; they have only one approach to measuring GDP; or they have two or more approaches, but only one is derived independently, with one component in the other(s) derived as a residual. Besides the analytical interest of having different approaches, however, discrepancies can be useful pointers to data problems that would otherwise be undiagnosed.

**46** For both supply and use and independent measures of GDP, investigation and resolution of the problems is the ideal method of balancing. The processes of confrontation and balancing at a detailed level can identify many issues and are highly regarded by national accounts compilers. The extent of adjustment that can be made should depend on the expertise of the statistical compilers. Adjustment should not be made lightly, but should be based on evidence and be well documented. There is potential for concern if uninformed guesses are made or adjustments are made with a view to meeting some political objective (or that accusations could be made that politically motivated manipulation has occurred). Adjustments should be monitored to see if they later need to be reversed.

**47** For cases in which there is insufficient time, expertise, or information for investigation to achieve complete balancing, there are a number of alternatives for treating the discrepancies. There is no international consensus, however, and treatments must account for national circumstances.

**48** One technique to remove discrepancies is the allocation of discrepancies to a single category by convention. The discrepancy is, then, no longer apparent. Usually, the chosen category is large (such as household consumption) or poorly measured (such as changes in inventories). In effect, the estimates are no longer independent, and one source is forced to equal the other. As a consequence, the information content of the chosen component is reduced or even lost. And although the discrepancy is hidden in this way, it is not solved. At least, the component should be properly labeled: for example, as "changes in inventories plus statistical discrepancy."

**49** A related option for removing the remaining discrepancies is to allocate them by mathematical or mechanical techniques across a number of categories. The chosen categories could be a selected group or all categories. Methods may involve simple or iterative prorating; for example, an iterative prorating method (called "RAS") can be used for SUT and other multidimensional balancing situations. The selection of which categories to adjust by prorating and which categories to leave unchanged should be based on explicit assessments of which estimates were better. A more sophisticated approach can be designed to preserve the movements in the original series. The multivariate Denton technique presented in Chapter 6 (or the equivalent two-step approach) can be used to eliminate temporal and cross-sectional discrepancies with the least possible impact on the period-to-period rates.

**50** Like allocation to a single category, allocation of the discrepancies across several categories may be achieved at the expense of damaging the time-series quality of the individual components. If an error that belongs in one component is distributed across a number of components (whatever is the reconciliation technique used), all the components will be less accurate. If the discrepancies are trivial, this may not be of concern. But if they are significant, these techniques merely hide the problem rather than solving it. It is a disservice to users to leave them unaware of the actual extent of uncertainty. Minimizing problems in data sources can also undermine the attempts of national accountants to highlight those problems and reduce the chance of bringing about improvements. Because of the greater significance of timing problems in source data and the reduced time for investigation of the causes of inconsistencies, the limitations of balancing are more serious in QNA than in ANA. As a result, some countries that have balanced ANA allow imbalances in QNA.

**51** The alternative to balancing by investigation, allocation to a single component, or mathematical removal is to present the remaining discrepancies openly. Within that alternative, one presentation is to publish more than one measure of GDP or supply and use of a product. Alternatively, a single measure can be identified as preferred on the basis of a qualitative assessment of data sources or mathematical testing of the properties of the alternative measures (or a mixture of them). Explicit statistical discrepancy items would then be needed (in aggregate for independent measures of GDP and at the product level for supply and use), so that the sum of the items equals the preferred total.

**52** The main concerns about showing explicit discrepancies are that they may cause confusion among users and criticism or embarrassment to the compilers. To the extent that the discrepancies represent problems that have identifiable causes and can be solved, the criticism is justified and investigations should have been carried out to make appropriate adjustments. To the extent that the discrepancies are trivial, mechanical techniques would be justified to remove them. In the remaining cases where the differences are significant and the causes unknown, however, it is better to admit the limitations of the data because the uncertainty is genuine. The ultimate objective must be to solve the problem, and being transparent to users about shortcomings is more likely to help bring about the required changes in data collection or compilation resources. While it is understandable that some compilers might be inclined to "sweep problems under the carpet," in the longer term, being open will avoid even more serious—and valid—criticism about secretiveness and covering up important problems.

**53** The objective of soundly based balancing is the same in both ANA and QNA. Similarly, the options and considerations to be taken into account in choosing between them apply in both situations. There are, however, some procedural and practical differences. Procedurally, QNA balancing problems are likely to be most severe for the most recent quarters; because for earlier quarters, the same issues would already have been identified in the ANA. Benchmarking brings the benefits of annual balancing to QNA, so that additional quarterly balancing may be a lower priority. There are also practical considerations, because there is less opportunity to investigate discrepancies during quarterly compilation.

**54** Benchmarking means that QNA will benefit indirectly from the balancing carried out on the annual data, so that discrepancies may be smaller and balancing less urgent. If the ANA are already balanced and the QNA are benchmarked, the need for separate balancing is reduced. For the balanced years, discrepancies within quarters will cancel out over the whole year and tend to be small. For quarters outside the annually reconciled period, the discrepancies will tend to be smaller, close to the benchmark years. For the most recent quarters that have no annual benchmark, if the indicators correctly track their benchmarks, previously identified causes of inconsistencies will already have resulted in adjustments that are carried forward. Accordingly, the QNA discrepancies will tend to be limited to those caused by noise, divergence between benchmarks and indicators, or data problems that have emerged since the last benchmark. Of course, if the annual data contain unreconciled inconsistencies, they will also be carried forward to the QNA, which will be at least as imbalanced as their ANA equivalents. The implications of benchmarking for balancing are discussed further in Chapter 6.

**55** QNA are typically compiled with less time, information, and detail than ANA. The reduced time and information tend to restrict the capacity to investigate problems that have emerged in the most recent quarters. Timing errors and statistical noise may be difficult to resolve by investigation. These issues are more significant in QNA because they tend to cancel out over a whole year. In terms of user interests, analysis of QNA tends to strongly emphasize the time-series aspects of QNA data rather than structural relationships. Also, in a quarterly supply and use system, the tables are compilation tools and are not generally published in their own right, so that time-series consistency is given more weight than structural balance. Therefore, there is likely to be less investigation and more acceptance of unresolved discrepancies in a QNA system than an ANA system.

## A Supply and Use Model for Editing the Quarterly GDP

**56** Quarterly GDP is typically calculated by aggregating a limited number of components, derived either from the production side (i.e., gross value added of economic activities plus net taxes on products) or from the expenditure side (i.e., consumption plus capital formation plus net exports). In most countries, the production approach is chosen as the preferred approach for deriving the official quarterly GDP measure. The production-based GDP is then used as a predetermined variable in the expenditure breakdown. This situation generally leads to two consequences: one is to derive one of the expenditure items residually (such as changes in inventories or household consumption), the other is to present statistical discrepancies as a residual item between the production-based GDP and the sum of the expenditure components. Either way, the inconsistencies between expenditure and production components are not properly investigated and addressed. As a result, the quality of the quarterly GDP may be undermined.

**57** One way to achieve consistent quarterly GDP data at a detailed product level is to compile SUT at the quarterly level. A set of SUT is considered the best framework for GDP compilation in the *2008 SNA*, at any frequency. Some countries with sophisticated national accounts systems derive the official quarterly GDP from quarterly SUT.[6] In effect, the main advantage of using a supply and use framework is to help fill data gaps of specific items with missing information, which could be a very complicated task in a QNA system based on aggregate variables. However, developing a quarterly supply and use system may be too demanding in terms of resources. Countries should be aware that preconditions for a successful development of quarterly SUT are to have a well-established system of annual SUT, sophisticated staff with significant SUT expertise, and willingness to revolutionize the existing QNA compilation system.

**58** Alternatively, SUT can offer a convenient framework to evaluate the consistency of quarterly GDP data derived at a more aggregate level. SUT are progressively being adopted by countries as the main framework for calculating benchmark years of national accounts. Countries with sophisticated systems of national accounts are producing SUT every year, which are used to obtain detailed and consistent annual estimates of the GDP. The availability of SUT (either for a benchmark year or updated every year) should also be exploited for improving the quality of quarterly data.[7]

**59** The validation process should be performed by means of a simplified quarterly supply and use model derived on the basis of assumptions from the most recent annual SUT. Some countries have recently developed quarterly supply and use models for editing the quarterly estimates.[8] This section draws from this experience and tries to present a systematic approach for editing the quarterly GDP using a quarterly supply and use model.

**60** The main advantage of using SUT in the editing process of the quarterly GDP is that inconsistencies calculated at the aggregate level can be transformed into detailed imbalances between total supply and total use of specific products (or between total output and total input of specific economic activities, if the fixed IO ratio assumption is relaxed). This detailed view permits to pinpoint the major sources of inconsistencies and allows the compilers to identify the most critical areas of intervention. The editing process should be reiterated until the quarterly GDP data show a satisfactory degree of consistency in the quarterly supply and use model.

**61** This editing tool can be helpful in assessing the consistency of both quarters that are benchmarked to closed years and quarters that are extrapolated from the latest annual benchmark. Although the quarterly data are benchmarked to consistent annual data, they may still lack consistency at the quarterly level due to seasonal effects, outliers, and other sub-annual effects. These effects may introduce distortions in the measurement of short-term changes of the GDP, with possible consequences in the identification of

[6] For example, the Netherlands has a long history of compiling supply and use tables at the quarterly level (see De Boer and others, 1999). Annual and quarterly aggregates are derived as the sum of detailed components in the quarterly supply and use tables.

[7] See Eurostat (2008) for a comprehensive description on supply and use tables in the national accounts. This section assumes that the reader is familiar with the supply and use methodology.

[8] Three examples of countries using a supply and use model as an editing tool for the quarterly gross domestic product are Australia (Lichtwark, 2006), Canada (Tebrake, 2013), and United Kingdom (Compton, 2008).

business-cycle turning points. In extrapolation, a supply and use model for validation can be particularly useful in verifying that the quarterly aggregate GDP figures are internally consistent.

**62** A small example is presented in this section to explain some basic ideas underlying the construction of a quarterly supply and use model for editing the quarterly GDP.[9] Example 9.1 shows a simple set of annual SUT, with a breakdown of four products and four economic activities (see the notes below the table for further details). Example 9.2 contains two independent estimates of the quarterly GDP by production (GDP-P) and by expenditure (GDP-E) for the subsequent year. The last row in the table shows the aggregate discrepancy between GDP-P and GDP-E. The objective of the example is to show how it is possible to develop a quarterly supply and use model from the available annual SUT that makes it possible to distribute the aggregate GDP discrepancy into specific product imbalances.

**63** The quarterly supply and use model described here is applied to seasonally adjusted data in volume terms. A quarterly supply and use model should be based on ratios calculated from annual SUT. The next section discusses the most sensible assumptions when it comes to construct quarterly tables from annual ones. Annual-to-quarter assumptions work better for volume estimates than for nominal estimates, as the price component may be subject to sudden changes even in the short term. For example, large swings in international oil prices can modify remarkably the IO ratios of energy-intensive industries. Similarly, assumptions from annual SUT are better suited for seasonally adjusted data. Seasonal effects may change the annual relationships between variables, so it would be inappropriate to apply annual ratios to distribute quarterly patterns not adjusted for seasonality. It should be noted, however, that seasonally adjusted data may be revised frequently, especially for the most recent quarters. This could introduce noise in the validation process of supply and use models using seasonally adjusted data.

### *Construction of a Quarterly Supply and Use Model*

**64** The first step in the construction of a quarterly supply and use model is to create a domestic output table (at basic prices) from the production-based GDP estimates. The domestic output table distributes output by economic activity (columns) into primary and secondary products (rows). Quarterly gross output is usually calculated in the QNA system by economic activity, very often by assuming a stable relationship with gross value added (in volume terms).[10] A quarterly distribution of the output of economic activities can be made by taking the shares of primary and secondary products from the (most recent) annual SUT. This assumption should not be critical, because the mix of products produced by an industry (in volume terms and seasonally adjusted) should remain fairly stable in the short term. A quarterly domestic output table is derived in Example 9.3, using the aggregate quarterly GDP data given in Example 9.2 and the ratios calculated from the annual SUT given in Example 9.1.

**65** The next step is to populate the remaining elements of the supply table. Quarterly data of imports are readily accessible with sufficient detail from the merchandise trade statistics and balance of payments data; therefore, it should not be complicated to fill the imports column with actual data. In absence of detailed data, the structure of imports from the annual SUT can be used to distribute total quarterly imports of goods and services (this assumption is used in the example). However, this assumption may not work well for economies with large shares of imported capital goods, which can cause swift changes in the mix of imports.

**66** The supply table is completed with the transformation of basic prices into purchasers' prices, which is the valuation needed to conform the product supply to the use table. The first transformation required is to allocate trade and transportation margins (i.e., distributive margins) among the various products.

[9] For space reasons, the example shown in this section presents a small and very stylized set of supply and use tables. Furthermore, some assumptions may not adapt well to country-specific situations. In practical applications, the adoption of quarterly-supply models for editing the quarterly GDP should be more complex than the simplified framework presented in this chapter. Moreover, actual data should replace assumptions whenever they are available (e.g., exports and imports data are available from merchandise trade statistics).

[10] Some countries calculate directly gross value added in the quarterly national accounts system. For the development of a quarterly supply and use model, the calculation of quarterly gross output (and quarterly intermediate consumption) is essential.

**Example 9.1 Annual Supply and Use Tables**

| Supply Table | | Agriculture (1) | Industry (2) | Distributive Services (3) | Other Services (4) | Total Supply at Basic Prices (5) | Imports (6) | Distributive Margins (7) | Net Taxes on Products (8) | Total Supply at Purchasers' Prices (9) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Agriculture | 56.1 | 0.0 | 0.2 | 0.0 | 56.4 | 6.4 | 11.0 | 1.6 | **75.4** |
| (2) | Industry | 0.3 | 399.3 | 5.1 | 5.1 | 409.9 | 154.5 | 111.8 | 35.0 | **711.1** |
| (3) | Distributive Margins | 0.1 | 6.6 | 110.3 | 5.8 | 122.8 | 0.0 | -122.8 | 0.0 | **0.0** |
| (4) | Services | 0.4 | 12.1 | 10.9 | 387.6 | 411.0 | 25.5 | 0.0 | 15.1 | **451.6** |
| **(5)** | **Total** | **56.9** | **418.0** | **126.5** | **398.6** | **1,000.0** | 186.4 | 0.0 | 51.6 | **1,238.0** |

| Use Table | | Agriculture (1) | Industry (2) | Distributive Services (3) | Other Services (4) | Total Intermediate Uses (5) | Household Consumption (6) | Government Consumption (7) | Gross Fixed Capital Formation (8) | Changes in Inventories (9) | Exports (10) | Total Final Uses (11) | Total Use at Purchasers' Prices (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Agriculture | 14.6 | 17.0 | 1.6 | 2.6 | 35.8 | 22.8 | 0.0 | 0.4 | 2.5 | 13.9 | 39.6 | **75.4** |
| (2) | Industry | 5.6 | 239.2 | 20.1 | 48.0 | 312.9 | 132.3 | 4.7 | 89.6 | 6.6 | 165.0 | 398.2 | **711.1** |
| (3) | Distributive Margins | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| (4) | Services | 1.1 | 51.5 | 36.2 | 100.9 | 189.6 | 126.2 | 98.5 | 13.5 | 0.0 | 23.7 | 261.9 | **451.6** |
| **(5)** | **Total** | 21.3 | 307.7 | 57.9 | 151.5 | 538.3 | 281.3 | 103.2 | 103.5 | 9.1 | 202.6 | 699.7 | **1,238.0** |
| (6) | Gross Value Added | 35.6 | 110.3 | 68.7 | 247.1 | 461.7 | | | | | | | |
| **(7)** | **Total Output** | **56.9** | **418.0** | **126.5** | **398.6** | **1,000.0** | | | | | | | |

(Rounding errors in the table may occur.)

**Annual Supply and Use Tables for 2010**

Example 9.1 shows a simplified system of supply and use tables for the year 2010. The detail level of the tables is four products (rows) and four economic activities (columns), including agriculture (column 1), industry (column 2), distributive services/margins (column 3), and other services (column 4). In the supply table, the domestic output table contains primary and secondary production activities. Total domestic output at basic prices is 1,000 units.

The supply table is completed with imports (column 6), redistribution of margins by product (column 7), and net taxes on products (column 8). Total supply at purchasers' prices is 1,238 units.

Rows from 1 to 5 of the use table show how the product supply is allocated to intermediate and final uses. Total use at purchasers' prices is 1,238 units, matching the total value in the supply table. By columns 1–5, the use table shows the output distribution by intermediate consumption (at purchasers' prices) and gross value added (at basic prices) for each economic activity.

The 2010 supply and use tables are balanced and provide benchmarks for the quarterly accounts.

This calculation can be done using the structure of margins by product from the annual SUT. Because the total amount of margins is known from the output table, the initial allocation of margins by product has to be reconciled with the total amount. A similar two-step transformation is done for taxes less subsidies on products. The initial allocation of net taxes based on the flows of output is reconciled with the total quarterly net taxes provided by government data. Example 9.4 shows the steps to calculate a quarterly supply table at purchasers' prices.

**67** The intermediate consumption table should also be linked to the production-based GDP estimates. Intermediation consumption by industry should preserve the fixed (or stable) relationship between gross value added and gross output. Hence, total costs by industry are to be distributed based on the input structure in the annual SUT. A high degree

**Example 9.2 Quarterly GDP by Production and by Expenditure**

| **GDP by Production (GDP-P)** | | | | | |
|---|---|---|---|---|---|
| *Gross Output* | q1 2011 | q2 2011 | q3 2011 | q4 2011 | *2011* |
| Agriculture | 14.6 | 14.7 | 15.0 | 14.7 | *59.0* |
| Industry | 108.0 | 107.2 | 105.9 | 106.4 | *427.5* |
| Distributive Services | 32.7 | 32.6 | 32.9 | 32.9 | *131.2* |
| Other Services | 102.2 | 102.3 | 101.7 | 102.4 | *408.5* |
| **Total Output** | **257.5** | **256.8** | **255.5** | **256.4** | ***1,026.2*** |
| *Intermediate Consumption* | q1 2011 | q2 2011 | q3 2011 | q4 2011 | *2011* |
| Agriculture | 5.4 | 5.5 | 5.6 | 5.4 | *21.9* |
| Industry | 79.3 | 78.8 | 77.8 | 78.2 | *314.1* |
| Distributive Services | 14.9 | 14.9 | 15.0 | 15.0 | *59.8* |
| Other Services | 38.9 | 38.9 | 38.7 | 38.9 | *155.4* |
| **Total Intermediate Consumption** | **138.6** | **138.0** | **137.1** | **137.6** | ***551.2*** |
| *Gross Value Added* | q1 2011 | q2 2011 | q3 2011 | q4 2011 | *2011* |
| Agriculture | 9.2 | 9.3 | 9.4 | 9.2 | *37.1* |
| Industry | 28.6 | 28.4 | 28.1 | 28.2 | *113.4* |
| Distributive Services | 17.8 | 17.8 | 17.9 | 17.9 | *71.3* |
| Other Services | 63.3 | 63.4 | 63.0 | 63.4 | *253.1* |
| Net Taxes on Products | 13.2 | 13.1 | 13.3 | 13.2 | *52.8* |
| **GDP-P** | **132.2** | **132.0** | **131.7** | **132.0** | ***527.8*** |
| **GDP by Expenditure (GDP-E)** | | | | | |
| | q1 2011 | q2 2011 | q3 2011 | q4 2011 | *2011* |
| Household Consumption | 72.2 | 72.0 | 71.8 | 71.9 | *287.9* |
| Government Consumption | 26.0 | 26.1 | 26.1 | 26.2 | *104.5* |
| Gross Fixed Capital Formation | 26.9 | 26.8 | 26.5 | 27.2 | *107.4* |
| Changes in Inventories | 2.0 | 2.5 | 1.1 | 0.5 | *6.1* |
| Exports | 53.5 | 53.5 | 53.2 | 54.1 | *214.4* |
| Imports | 48.4 | 48.7 | 47.8 | 48.4 | *193.3* |
| **GDP-E** | **132.3** | **132.2** | **130.9** | **131.5** | ***526.9*** |
| **GDP-P – GDP-E** | ***–0.1*** | ***–0.3*** | ***0.7*** | ***0.6*** | ***0.9*** |

(Rounding errors in the table may occur.)

**Quarterly GDP Estimates for 2011**

Example 9.2 contains quarterly GDP data for the year 2011 disaggregated by production components (i.e., gross output, intermediate consumption, and gross value added by economic activities plus net taxes) and expenditure items (i.e., main final user categories). The classification of the quarterly GDP is consistent with the annual supply and use tables shown in Example 9.1. The quarterly data are assumed to be in volume terms, additive, and seasonally adjusted. The last column reports the annual sum of the corresponding quarterly values.

Gross value added (GVA) by industry is calculated as the difference between gross output and intermediate consumption plus net taxes. GVA is derived assuming stability between output and intermediate consumption.

The two GDP estimates are independently derived. The last line of the table shows the discrepancies between GDP-P and GDP-E. The annual discrepancy is 0.9 units, mostly concentrated in the last two quarters of the year (0.7 and 0.6, respectively). No product/industry breakdown of the discrepancies is available.

of homogeneity in the inputs is reasonable in the short run. Example 9.5 shows the construction of quarterly intermediate consumption tables.

**68** The last step in the calculation of quarterly SUT is to break down the final demand components of the quarterly GDP by product. The use table should be based on quarterly estimates of expenditure components that are as much as possible independent from the production-based quarterly GDP estimates. The quarterly use table is presented in Example 9.6.

**69** The quarterly total flows in the use table are distributed by product using (again) the simplest

## Example 9.3 Quarterly Domestic Output Table at Basic Prices

| Output Share by Product (%) for 2010 | | Agriculture (1) | Industry (2) | Distributive Services (3) | Other Services (4) |
|---|---|---|---|---|---|
| (1) | Agriculture | 98.64 | 0.01 | 0.17 | 0.00 |
| (2) | Industry | 0.57 | 95.54 | 4.02 | 1.28 |
| (3) | Distributive Margins | 0.17 | 1.57 | 87.18 | 1.46 |
| (4) | Other Services | 0.62 | 2.89 | 8.63 | 97.26 |
| **(5)** | **Total** | **100.00** | **100.00** | **100.00** | **100.00** |

| Output at Basic Prices for q3 2011 | | Agriculture (1) | Industry (2) | Distributive Services (3) | Other Services (4) | Total Output at Basic Prices (5) |
|---|---|---|---|---|---|---|
| (1) | Agriculture | 14.8 | 0.0 | 0.1 | 0.0 | 14.8 |
| (2) | Industry | 0.1 | 101.2 | 1.3 | 1.3 | 103.9 |
| (3) | Distributive margins | 0.0 | 1.7 | 28.7 | 1.5 | 31.9 |
| (4) | Other services | 0.1 | 3.1 | 2.8 | 98.9 | 104.9 |
| **(5)** | **Total** | **15.0** | **105.9** | **32.9** | **101.7** | **255.5** |

(Rounding errors in the table may occur.)

**Calculation of Quarterly Domestic Output Table for q3 2011**

In this example, quarterly output is available only by economic activity. The first step in the calculation of the quarterly supply and use model is to create a domestic output table where the industry output is distributed by product. This is done by taking into account the primary and secondary activities in the 2010 annual supply and use tables shown in Example 9.1.

The 2010 output shares of industries by product are shown in the top table. For example, 98.64 percent of the agriculture output is made of agricultural products, 0.57 percent by industrial products (mining, manufacturing, electricity, and construction), 0.17 percent by margins, and 0.62 percent by other services.

The annual shares for 2010 are used to distribute the quarterly output by product. For sake of simplicity, only the table for q3 2011 (third quarter of 2011) is presented. Total output by economic activity in q3 2011 (shown in row 5 and taken from Example 9.2) is distributed according to the percentage shares shown in the top table (figures are rounded to one decimal place). For example,

| | |
|---|---|
| Output of industrial goods produced by industry in q3 2011 | = 105.9 × 0.9554 = 101.2 |
| Output of industrial goods produced by distributive services in q3 2011 | = 32.9 × 0.0402 = 1.3 |
| Output of other services produced by agriculture in q3 2011 | = 15.0 × 0.0062 = 0.1. |

Column 5 calculates the sum of output by product at basic prices.

assumption: namely, by assuming that the annual shares in the SUT for each demand category remain stable in the following quarters. This assumption can be satisfactory for household consumption, which presents fairly regular patterns dominated by frequent purchases (food, housing, transportation, etc.). However, this assumption may not hold true, even in the short term, for other demand categories. For example, purchases of certain capital goods may be very volatile, which can introduce substantial differences with respect to the supply and use shares. The same can happen with exports, especially for small-open economies. Once again, this assumption may work well only for quarterly seasonally adjusted data.

**70** For changes in inventories, it is very unlikely that the product allocation in a year remain the same for following periods. Inventory levels can move very rapidly between quarters due to different phases in the economy, movements that can modify substantially the product shares estimated in the annual SUT. An alternative assumption for calculating quarterly inventories in the supply and use model is to link the

**Example 9.4 Quarterly Supply Table at Purchasers' Prices**

| Total Supply for q3 2011 | Total Output at Basic Prices (1) | Imports (2) | Total Supply at Basic Prices (3) = (2) + (1) | Distributive Margins: Distributive Margins from Annual Supply-use Ratios (4) | Distributive Margins: Reconciled with Total Margins in q3 2011 (5) | Distributive Margins: Difference (6) = (5) – (4) | Net Taxes on Products: Net Taxes on Products from Annual Supply and Use Ratios (7) | Net Taxes on Products: Reconciled with Total Net Taxes on Products in q3 2011 (8) | Net Taxes on Products: Difference (9) = (8) – (7) | Total Supply at Purchasers' Prices (10) = (3) + (5) + (8) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) Agriculture | 14.8 | 1.7 | 16.6 | 2.9 | 2.9 | 0.1 | 0.4 | 0.4 | 0.0 | 19.9 |
| (2) Industry | 103.9 | 39.6 | 143.5 | 28.4 | 28.9 | 0.5 | 8.9 | 9.0 | 0.1 | 181.4 |
| (3) Distributive Margins | 31.9 | 0.0 | 31.9 | –31.3 | –31.9 | –0.6 | 0.0 | 0.0 | 0.0 | 0.0 |
| (4) Other Services | 104.9 | 6.5 | 111.4 | 0.0 | 0.0 | 0.0 | 3.9 | 3.9 | 0.0 | 115.3 |
| **(5) Total** | **255.5** | **47.8** | **303.3** | **0.0** | **0.0** | **0.0** | **13.2** | **13.3** | **0.1** | **316.6** |

(Rounding errors in the table may occur.)

**Calculation of Quarterly Supply Table at Purchasers' Prices for q3 2011**

Example 9.4 shows the steps to derive a total supply table at purchasers' prices. Column 1 reports the gross output at basic prices from Example 9.3.

The distribution of imports by product is done according to the imports share by product of year 2010. However, a share distribution of imports and exports is often unnecessary in real-life applications. Quarterly data for imports and exports at a detail product level can be drawn from merchandise trade statistics. No adjustment for shipping and insurance costs is done for simplicity.

To transform basic prices into purchasers' prices, distributive margins should be reallocated to the products they apply to. This is done in two steps. First, distributive margins by product are calculated by applying the share of distributive margins over total supply at basic prices (domestic output plus imports) in 2010. The shares of distributive margins for agricultural and industrial products at basic prices in 2010 are as follows:

Margin share on agriculture products in 2010: 11.0/(56.4 + 6.4) = 11.0/62.8 = 17.52%
Margin share on industrial products in 2010: 111.8/(409.9 + 154.5) = 111.8/564.4 = 19.81%.

This share is applied to total agriculture and industry supply at basic prices in q3 2011: that is,

Margins for agriculture products in q3 2011: 16.5 × 0.1752 = 2.9
Margins for industrial products in q3 2011: 143.5 × 0.1981 = 28.4.

The resulting sum of distributive margins in q3 2011 (31.3) must be reconciled with the total margins estimated in the domestic output table (31.9). It is assumed that this total is determined at an aggregate level, without the use of detailed supply and use relationships. The difference (–0.6) is redistributed in column 5 proportionally to the size of agriculture and industrial margins.

A similar approach is taken for the distribution of net taxes on products. A preliminary distribution by product is generated by taking the 2010 supply and use ratios of net taxes over supply. The difference with total net taxes on products derived at an aggregate level (13.3, given in Example 9.2) is redistributed proportionally in column 8.

Column 10 derives the total supply at purchasers' prices as the sum of total supply at basic prices (column 3), distributive margins (column 5), and net taxes on products (column 8). This column will compare with the total uses at purchasers' prices derived in Examples 9.5 and 9.6.

opening and closing levels of inventories to the supply of products (output plus imports). The difference between the closing and opening stocks would give an estimate of the changes in each quarter. In the example, however, the quarterly distribution of changes in inventories based on the annual SUT is preferred for practical reasons.

### *Adjustments to Resolve Imbalances*

**71** Once all the elements of the quarterly SUT are generated and put into place, it is possible to compare and analyze the discrepancies between total supply and total use for each individual product. This is the main objective of using SUT for editing the quarterly GDP. Although the quarterly tables are constructed

**Example 9.5 Quarterly Intermediate Consumption Table**

| Input Shares (%) for 2010 | | Agriculture (1) | Industry (2) | Distributive Services (3) | Other Services (4) |
|---|---|---|---|---|---|
| (1) | Agriculture | 68.64 | 5.52 | 2.71 | 1.75 |
| (2) | Industry | 26.08 | 77.75 | 34.79 | 31.67 |
| (3) | Distributive Margins | 0.00 | 0.00 | 0.00 | 0.00 |
| (4) | Other Services | 5.28 | 16.74 | 62.51 | 66.59 |
| **(5)** | **Total** | **100.00** | **100.00** | **100.00** | **100.00** |

| Intermediate Consumption Table for q3 2011 | | Agriculture (1) | Industry (2) | Distributive Services (3) | Other Services (4) | Total Intermediate Uses (5) |
|---|---|---|---|---|---|---|
| (1) | Agriculture | 3.8 | 4.3 | 0.4 | 0.7 | 9.2 |
| (2) | Industry | 1.4 | 60.5 | 5.2 | 12.2 | 79.4 |
| (3) | Distributive Margins | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| (4) | Other Services | 0.3 | 13.0 | 9.4 | 25.8 | 48.5 |
| **(5)** | **Total** | **5.6** | **77.8** | **15.0** | **38.7** | **137.1** |

(Rounding errors in the table may occur.)

**Calculation of Quarterly Intermediate Consumption Table for q3 2011**

On the use side, the first step is to calculate an intermediate consumption table for each quarter. Given the lack of information on intermediate inputs (even at the annual level), this table can only be derived on the basis of assumptions. The top table displays the input coefficients by industry derived from the 2010 supply and use tables shown in Example 9.1. Each column shows the percentage share of input (in percentage points) over total input costs by industry.

The q3 2011 total intermediate consumption by industry (row 5 in bottom table) are split according to the input shares of 2010. For example, the breakdown of intermediate costs of other services (38.7) are derived as follows:

Cost of agricultural products for other services industry: $38.7 \times 0.0175 = 0.7$
Cost of industrial products for other services industry: $38.7 \times 0.3167 = 12.2$
Cost of other services products for other services industry: $38.7 \times 0.6659 = 25.8$.

Column 5 derives by summation the total amount of intermediate use by product.

with several assumptions, they can provide a very useful insight into the sources of aggregate discrepancies arising from the aggregate quarterly GDP estimates. In Example 9.7, the aggregate quarterly discrepancies are distributed into product discrepancies by calculating the difference between total supply and total use at purchasers' prices.

**72** Product detail of the discrepancies reveals the areas in the accounts that generate the GDP inconsistencies. Specific actions should be taken to address and reduce the largest imbalances for each quarter. Changes should be introduced to the quarterly GDP estimates by production, the quarterly GDP estimates by expenditure, or both. After such changes are made, the quarterly supply and use model should be rebuilt to analyze their effects on the product imbalances. This process should be iterated until the quarterly GDP data are deemed consistent in the quarterly SUT framework.

**73** Product imbalances can arise for several reasons. It is a task for QNA compilers to understand their causes and find the most suitable remedy. The most frequent causes of inconsistency are lack of coherence between source data used in the production and expenditure approaches, residual seasonal effects in the seasonally adjusted data, differences in the price

### Example 9.6 Quarterly Final Use Table

| Product Shares (%) for 2010 | | Household Consumption (1) | Government Consumption (2) | Gross Fixed Capital Formation (3) | Changes in Inventories (4) | Exports (5) |
|---|---|---|---|---|---|---|
| (1) | Agriculture | 8.09 | 0.01 | 0.41 | 27.12 | 6.88 |
| (2) | Industry | 47.04 | 4.54 | 86.59 | 72.43 | 81.42 |
| (3) | Distributive Margins | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (4) | Other Services | 44.87 | 95.46 | 13.00 | 0.45 | 11.70 |
| **(5)** | **Total** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** |

| Final Use Table for q3 2011 | | Household Consumption (1) | Government Consumption (2) | Gross Fixed Capital Formation (3) | Changes in Inventories (4) | Exports (5) | Total Final Uses (6) |
|---|---|---|---|---|---|---|---|
| (1) | Agriculture | 5.8 | 0.0 | 0.1 | 0.3 | 3.7 | 9.9 |
| (2) | Industry | 33.8 | 1.2 | 22.9 | 0.8 | 43.3 | 102.0 |
| (3) | Distributive Margins | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| (4) | Other Services | 32.2 | 25.0 | 3.4 | 0.0 | 6.2 | 66.9 |
| **(5)** | **Total** | **71.8** | **26.1** | **26.5** | **1.1** | **53.2** | **178.8** |

(Rounding errors in the table may occur.)

**Calculation of Quarterly Final Use Table for q3 2011**

The quarterly final use table is based on the quarterly GDP estimates by expenditure shown in Example 9.2. The total quarterly amount of each demand category is distributed using the product shares from the final use table of 2010, which are shown in the top table of Example 9.6.

For example, the household consumption expenditures by product in q3 2011 are derived as follows:

Household consumption of agricultural products: 71.8 × 0.0809 = 5.8
Household consumption of industrial products: 71.8 × 0.4704 = 33.8
Household consumption of other services products: 71.8 × 0.4487 = 32.2.

A clarification on the distribution of changes in inventories is worth noting. For sake of exposition, it is assumed that the total changes in inventories is distributed using the share of changes in inventories from the previous year. This assumption is clearly unrealistic, even in the short term. Changes in inventories can be very volatile and may change from one quarter to the next. A better assumption could be to estimate the opening and closing stocks of inventories on the basis of quarterly output, and then derive the change as the difference between the closing stock and the opening stock of inventories by product. Even better, the column of changes in inventories should be populated with exogenous information on the quarterly changes in inventories from economic activities (primary commodities, oil, motor vehicles, etc.)

Column 6 contains the total final use by product at purchasers' prices.

and volume effects, ad hoc intervention to specific components, and diverging extrapolations of related production and expenditure components.

**74** During the iterative process, it may also be necessary to modify the assumptions from the annual SUT to better fit the quarterly estimates. For example, a large discrepancy between supply and use may call for a stronger accumulation of inventories than normal. A modification of the IO ratio can also be required when the aggregate estimates (and the underlying source data) signal a systematic imbalance between total supply and final uses. Sometimes, it could also be necessary to bring the production data in line with the expenditure estimate. The adjustment process should of course take into account the relative reliability of the estimates. Ideally, components that

**Example 9.7 Quarterly Discrepancies from the Supply and Use Model**

| Supply and Use in q1 2011 | | Total Supply at Purchasers' Prices (1) | Total Intermediate Uses (2) | Total Final Uses (3) | Total Uses at Purchasers' Prices (4) = (2) + (3) | Discrepancies (5) = (1) – (4) |
|---|---|---|---|---|---|---|
| (1) | Agriculture | 19.4 | 9.2 | 10.2 | 19.4 | *0.1* |
| (2) | Industry | 183.8 | 80.6 | 103.5 | 184.1 | *–0.2* |
| (3) | Distributive Margins | 0.0 | 0.0 | 0.0 | 0.0 | *0.0* |
| (4) | Other Services | 115.9 | 48.8 | 67.0 | 115.8 | *0.1* |
| (5) | Total | 319.2 | 138.6 | 180.7 | 319.2 | *–0.1* |
| **Supply and Use in q2 2011** | | | | | | |
| (1) | Agriculture | 19.5 | 9.2 | 10.3 | 19.5 | *0.1* |
| (2) | Industry | 183.2 | 80.2 | 103.6 | 183.8 | *–0.7* |
| (3) | Distributive Margins | 0.0 | 0.0 | 0.0 | 0.0 | *0.0* |
| (4) | Other Services | 116.0 | 48.7 | 67.0 | 115.6 | *0.3* |
| (5) | Total | 318.6 | 138.0 | 180.9 | 318.9 | *–0.3* |
| **Supply and Use in q3 2011** | | | | | | |
| (1) | Agriculture | 19.9 | 9.2 | 9.9 | 19.1 | *0.8* |
| (2) | Industry | 181.4 | 79.4 | 102.0 | 181.5 | *0.0* |
| (3) | Distributive Margins | 0.0 | 0.0 | 0.0 | 0.0 | *0.0* |
| (4) | Other Services | 115.3 | 48.5 | 66.9 | 115.3 | *0.0* |
| (5) | Total | 316.6 | 137.1 | 178.8 | 315.8 | *0.7* |
| **Supply and Use in q4 2011** | | | | | | |
| (1) | Agriculture | 19.5 | 9.1 | 9.8 | 18.9 | *0.6* |
| (2) | Industry | 182.4 | 79.8 | 102.9 | 182.7 | *–0.3* |
| (3) | Distributive Margins | 0.0 | 0.0 | 0.0 | 0.0 | *0.0* |
| (4) | Other Services | 116.1 | 48.7 | 67.1 | 115.8 | *0.3* |
| (5) | Total | 318.0 | 137.6 | 179.9 | 317.5 | *0.6* |

(Rounding errors in the table may occur.)

**Detailed Quarterly Discrepancies between Total Supply and Total Use for q1 2011–q4 2011**

Example 9.7 integrates the quarterly supply and use tables obtained for all the quarters of 2011. Total supply is reported in column 1, whereas total use (as the sum of intermediate and final uses) is derived in column 4. The quarterly supply and use discrepancies by product are shown in column 5. It can be seen that the total quarterly discrepancies (shown in row 5) match the quarterly GDP discrepancies presented in the last row of Example 9.2. However, with a quarterly supply and use model, compilers have a chance to look at the discrepancies distributed by product.

This tool makes it possible to identify areas of possible intervention to address and reduce the GDP discrepancies. In this particular example, the large discrepancies in q3 2011 and q4 2011 are due to an excessive supply (or lack of demand) of agricultural products. Changes to production and expenditure components in the quarterly (aggregate) GDP system can be tailored to make the supply and use of agricultural products more consistent with each other.

are based on less solid information should be altered more than components based on comprehensive source data.

**75** At the end of this process, small discrepancies in the quarterly supply and use model can be allocated to one GDP component (e.g., a large component such as household consumption). Alternatively, reconciliation techniques can be used to eliminate all the discrepancies analytically. Such techniques should adjust the estimates in a way such that the initial movements in the detailed components are preserved. Chapter 6 presents reconciliation solutions to perform this task in an optimal way.

### *Further Considerations*

**76** A priority when using SUT for editing the quarterly GDP is that all the assumptions made should maximally preserve the time-series properties of the QNA and avoid any breaks between quarters. Using seasonally adjusted data facilitates the application of annual ratios to distribute quarterly data. However, annual ratios taken from SUT of contiguous years (when available) can be substantially different. This could create steps between the last quarter of one year (based on a set of ratios from that year) and the first quarter of the following year (based on different SUT). In such cases, instead of using fixed quarterly ratios, the annual ratios in the two different years should be interpolated to smooth out the transition between the two levels.

**77** The construction of fully balanced (or nearly balanced) quarterly SUT in volume terms can also help analyze the consistency of the QNA figures at current prices. The final quarterly SUT at previous year's prices (or at constant prices) can be reflated with available price indices (producer prices, consumer prices, and imports and exports prices). Discrepancies in the resulting quarterly SUT at current prices can identify inconsistencies in the price statistics at a detailed product and industry level. Furthermore, the results from the quarterly supply and use model can be compared with the nominal estimates derived from the QNA system. In this way, a quarterly supply and use model can also be beneficial for improving the estimate of the GDP deflator.

**78** For QNA data unadjusted for seasonal effects, a quarterly supply and use model based on annual assumptions poses greater challenges. The relationship between economic variables can be highly seasonal. For example, the share of purchases of tourism services during a holiday period is certainly higher than the annual average. However, if proper assumptions about the seasonal variation can be made, a quarterly supply model for unadjusted data can help reveal inconsistencies between the seasonality of production and expenditure data. For example, seasonal peaks and troughs are expected to appear in the same quarters along the supply and use rows. A quarterly supply and use model built from unadjusted data could reveal inconsistencies when related QNA variables are based on indicators with diverging seasonal patterns.

**79** The level of detail for a quarterly supply and use model should be chosen with pragmatism. Theoretically, one may wish to build quarterly tables with hundreds of rows and columns to improve the robustness of the assumptions. However, the implied work for developing and maintaining large systems of quarterly SUT may be unsustainable. Quarterly SUT should be simplified versions of existing annual tables. The detail level of the QNA system is certainly to be considered when deciding the number and type of products and economic activities of the quarterly supply and use model.

**80** When the quarterly GDP is calculated only from the production approach, a quarterly supply and use model can be used to develop a rudimentary estimate of quarterly GDP by expenditure. Many countries do not produce quarterly GDP by expenditure because of lack of source data (i.e., lack of a continuous household consumption). Commodity-flow assumptions from available annual SUT (i.e., fixed shares in the use distribution) can be used to allocate the production-based estimates between the different uses. With this approach, however, the resulting GDP estimate by expenditure would be constructed from production-based GDP (no discrepancy would appear between the two estimates). Consequently, the quarterly GDP by expenditure could not be considered an independent measure of the GDP.

### Summary of Key Recommendations

- *Editing (or checking) procedures should be put in place to review all the different stages of the QNA calculation process and make sure that the final results satisfy all the national accounts relationships and provide a credible measurement of the economy.*
- *Editing procedures may result in changes in the estimates, which may involve fixing errors or adopting alternative sources and methods. However, all the changes should be documented with supporting evidence. The editing work should never be an excuse for manipulating data.*
- *Editing should be an integral part of the QNA compilation process. The compilation schedule needs to allow time for editing and subsequent investigation and revision of data.*
- *The editing process should be based on a number of logical and plausibility checks at all level of the QNA process (input data, intermediate results, and final estimates). Automated routines should be developed to monitor the QNA results quickly and continuously during the compilation process.*
- *In general, editing procedures are best applied at both detailed and aggregate levels. When annual supply and use tables are available, a quarterly supply and use model should be considered to transform the aggregate GDP discrepancies into detailed product imbalances. A detailed view facilitates the identification of the most critical areas of intervention for improving the quality of the quarterly GDP results.*

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